VIBRATION
IN
ARMY AVIATION

TERMINAL LEARNING OBJECTIVE

- ACTION: Manage the effects of vibration in Army aviation.
- CONDITIONS: While performing as an aircrew member.
- STANDARD: IAW FM 3-04.301 (FM 1-301) and Fundamentals of Aerospace Medicine.

Enabling Learning Objective 1

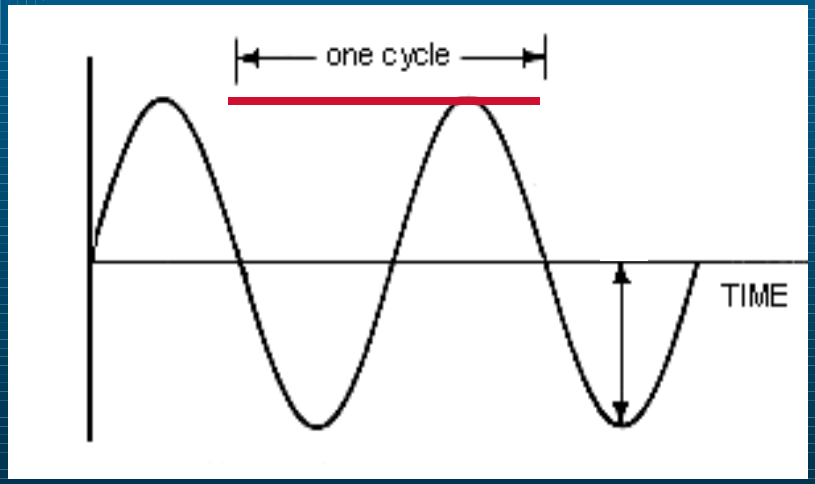
- ACTION: Identify vibration terminology.
- CONDITION: From a list.
- STANDARD: In accordance with (IAW) 3-04.301 (FM 1-301) and Fundamentals of Aerospace Medicine.

VIBRATION

The motion of an object relative to a reference position (object at rest) involving series of oscillations resulting in displacement and acceleration of an object.

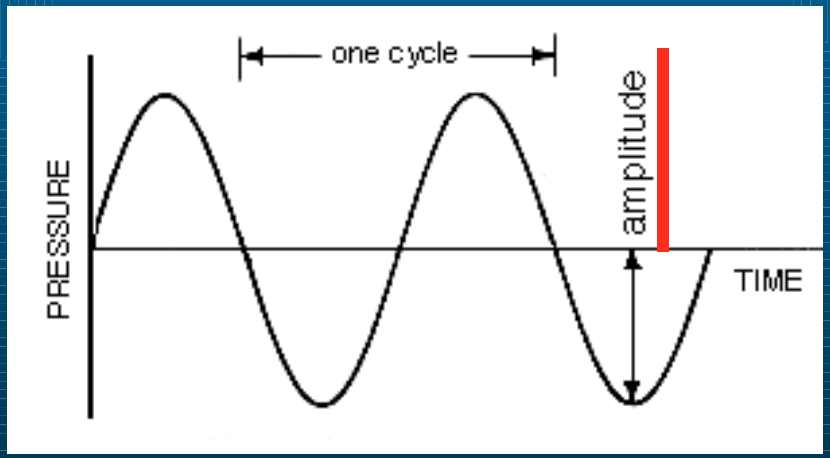
FREQUENCY

* Number of oscillations of any object in a given time.
* 1 cycle per second = 1 Hertz (Hz)



AMPLITUDE

The maximum displacement about a position at rest.



DURATION

Time of exposure

NATURAL BODY RESONANCE

The mechanical amplification of vibration by

the body occurring at specific frequencies

DAMPING

- Loss of mechanical energy in a vibrating system.
- Causes the vibration to slow down.
- Body’s connective tissue damps vibrations.

QUESTIONS?

Enabling Learning Objective 2

- ACTION: Identify the sources of vibration.
- CONDITION: Given a list.
- STANDARD: In accordance with (IAW) FM 3-04.301 (FM1-301) and Fundamentals of Aerospace Medicine.

SOURCES OF VIBRATION

SOURCES OF VIBRATION cont

- Weather (Turbulence) crewmembers may over control during turbulence.
- Increased air speed
- Internal and External Loading
- Most intense during transition from hover to cruise flight and cruise to hover.

QUESTIONS?

Enabling Learning Objective 3

- ACTION: Identify the effects of vibration on human performance during flight.
- CONDITION: From a list.
- STANDARD: In accordance with (IAW) FM 3-04.301 (FM 1-301) and Fundamentals of Aerospace Medicine.

MANUAL COORDINATION

- Coordination and control “touch” is degraded at 4-8 Hz.
- Aircrew member may over control during turbulence and or transition from hover to level flight.

VISION

- Instrument panel may be difficult to read. Due to reduced vision.
- Helmet mounts start to vibrate at 4-12 Hz.

SPEECH

- Can be distorted during oscillations of 4-12 Hz.
- Above 12 Hz, speech becomes increasingly difficult to interpret.

QUESTIONS?

Enabling Learning Objective 4

- ACTION: Identify the short-term effects of vibration.
- CONDITION: From a list.
- STANDARD: In accordance with (IAW) FM 3-04.301 (FM 1-301) and Fundamentals of Aerospace Medicine.

Resonation

Increase in amplitude

Creation of a momentum which increases in intensity with each

Body's Resonant Frequency

Body Part	**Resonant Frequency**
Whole body	**4-8 Hz**
Shoulder Girdle	**4-8 Hz**
Head	**25 Hz**
Eyes	**30-90 Hz**

FATIGUE

- Vibration causes the muscle to contract.
- Pressure receptors located in tendons and muscle measure angular position.
- The receptors respond to vibration causing contraction or tightening of the muscle.

RESPIRATORY EFFECTS

- Hyperventilation is caused when the diaphragm is vibrated at 4-8 Hz.
- Artificial respiration
- Increase pulse rate and blood pressure.

Circulatory Effects

The body interprets vibrations experienced during flying as exercise. Therefore, the muscular effort of bracing against vibration increases pulse

MOTION SICKNESS

- Vibration with a frequency of less than 1 Hz (slow rolling of a ship) can produce nausea in susceptible people.
- Neural Mismatch Theory.

DISORIENTATION

- Vibration affects the semicircular canals and the Otolith organs.

PAIN

- Pre-existing injuries.
  - Stress fractures
  - Back pain
  - Degenerative disc disease

QUESTIONS?

Enabling Learning Objective 5

- ACTION: Identify the long-term effects of vibration.
- CONDITION: From a list.
- STANDARD: In accordance with (IAW) FM 3-04.301 (FM 1-301) and Fundamentals of Aerospace Medicine.

RAYNAUD’S DISEASE

- Raynaud’s Disease - Prolong exposure to vibration.
- Trauma to arterioles and nerve endings in the extremities.

BACKACHE/BACK PAIN

- May result at an earlier age than normal.
- The lumbar spine is subjected to higher pressure while sitting.
- Vibration can cause premature degeneration of bone structures.

KIDNEY AND LUNG

Effects under scientific studies

QUESTIONS?

Enabling Learning Objective 6

- ACTION: Select the method(s) used to reduce the vibrational threat in Army Aviation.
- CONDITION: Given a list.

- STANDARD: In accordance with (IAW) FM 3-04.301 (FM 1-301) and Fundamentals of Aerospace Medicine.

REDUCTION OF VIBRATION

- Good posture during flight.

  Promotes good circulation.

- Restraint systems

  Protection against high magnitude vibration during extreme turbulence

REDUCTION OF VIBRATION cont.

- Body supports

  Reduce discomfort but could cause injury during a crash sequence.

- Maintain your equipment

  Blade tracking

- Isolate crewmembers / passengers

  Patients / Use of seatbelts

REDUCTION OF VIBRATION cont.

- Limit exposure time

  Short flights/frequent breaks rather than long flights (If mission permits)

- Let the aircraft do the work

  Tight grip on flight controls

  Transmission of vibration through flight controls

MAINTAIN EXCELLENT PHYSICAL CONDITION

- Fat multiplies vibration, muscles dampens vibration

  Lessen effects of fatigue / continue operations with minimum rest

- Maintain sufficient hydration

  Dehydration with vibration can cause fatigue twice as fast and longer recovery time

QUESTIONS?

SUMMARY

Conclusion